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THE REPORT

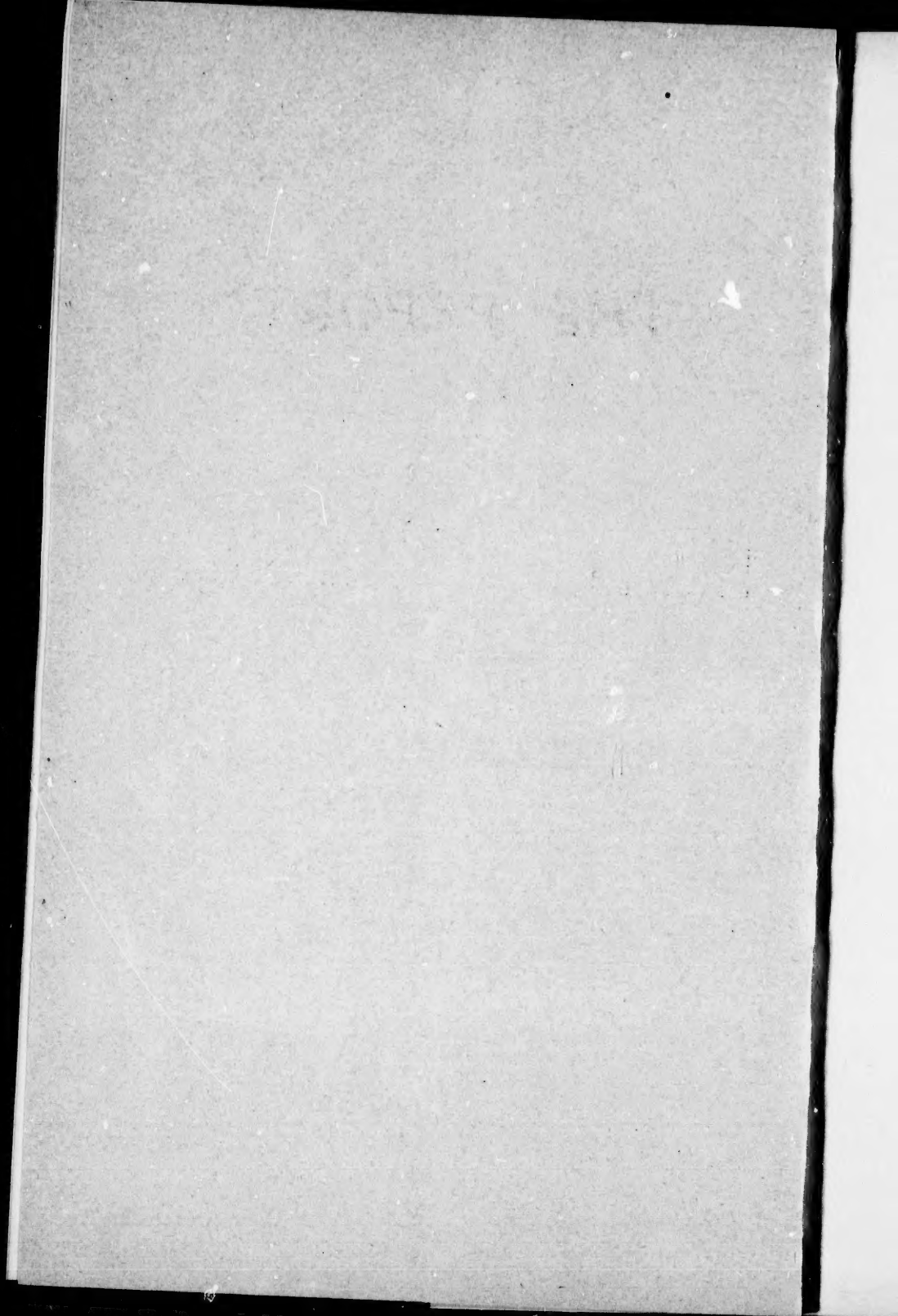
OF THE

PACIFIC CABLE COMMITTEE.

REPRINTED FROM

The ELECTRICAL REVIEW of June 9th, 16th, 23rd and 30th;
July 7th, 14th and 28th; August 4th, 11th and 18th; and September
8th, 1899.

X



The Report of the Pacific Cable Committee.

REPRINTED FROM THE "ELECTRICAL REVIEW."

IN the examination which we propose to make of the Report of the "Committee appointed to consider the proposal for laying a telegraph cable between British North America and the Colonies of Australasia," it appears to be best to divide the subject out as was done in the instrument of appointment of the Committee, in which the following questions were advanced for consideration, and for report to Her Majesty's Government:—

I.—Is the laying of such a cable practicable from a technical point of view?

II.—If so, what route should be selected for the cable?

III.—What will be the cost (*a*) of laying, (*b*) of maintaining, the cable, and (*c*) of the annual working expenses?

IV.—What revenue will arise from the traffic which may be expected to pass over the cable?

V.—Should the cable be owned and worked by Government or by a subsidised private company?

VI.—If the cable were to be national property, what would be the proper method of management and administration?

VII.—What should be the form of contract offered to a contractor for its construction?

The desire is also expressed that the Report should embody the views of the Committee "on any subsidiary questions of a practical nature which may arise during the investigation." The letter of appointment is dated June 2nd, 1896, and is signed by the Right Hon. J. Chamberlain.

The members of the Committee were the following :—

The Right Hon. William Waldegrave Earl of Salisbury, Under Secretary of State for the Colonies; George Herbert Murray, Esq., C.B., a principal clerk in the Department of the Treasury*; Sir Donald Alexander Smith, G.C.M.G., High Commissioner for Canada†; the Hon. Sir Mackenzie Bowell, K.C.M.G., Member of the Privy Council of Canada‡; the Hon. Sir Saul Samuel, K.C.M.G., C.B., Agent-General for New South Wales§; and the Hon. Duncan Gillies, Agent-General for Victoria||.

The Committee met in Downing Street on June 5th, 1896, and was then adjourned until October 26th, as the Telegraph Conference then being held at Buda-Pesth necessitated the absence of some of the delegates. Thus it was not until November 12th that the Committee began to take evidence, and we may say here that as all the evidence given was expressly stated to be "confidential," nothing, presumably, was known of its nature to those who were not present at the sittings until the publication of the report in April last, some two and a half years later. During the examination of witnesses the Committee had the advantage of the advice of Sir Sandford Fleming, K.C.M.G., and of Messrs. J. C. Lamb, C.B., C.M.G., and W. H. Preece, C.B., F.R.S.,¶ the two latter representing the Postmaster-General. The secretary to the Committee was Mr. W. H. Mercer, of the Colonial Office. During the 13 days which were passed in taking evidence, the following 26 witnesses were under examination :—Mr. Sandford Fleming, formerly engineer-in-chief to the Canadian-Pacific and to the Intercolonial Railways, acting as expert adviser to the Canadian representatives; Mr. M. H. Gray, submarine cable engineer-in-charge of the Silvertown Telegraph Company; Mr. Alexander Siemens, a director of Messrs. Siemens Bros.; Mr. Theophilus Smith, chief submarine cable engineer of the Henley Telegraph Company; Mr. F. R. Lucas, engineer-in-chief to the Telegraph Construction and Maintenance Company; Dr. Alexander Muirhead, joint inventor of the "duplex method," and of electrical apparatus; Mr. H. A. Taylor, partner in the firm of Clark, Forde and

* At present secretary to the Post Office.

† Now the Right Hon. Lord Strathcona and Mount Royal.

‡ Resigned before the Committee began to take evidence, the Hon. A. G. Jones being appointed in his place.

§ Since retired from Agency.

|| Since retired from Agency.

¶ Now Sir W. H. Preece, K.C.B.

Taylor; Capt. W. Goodsall, late commander of the Eastern Telegraph Company's ship *Chiltern*; Mr. W. H. Preece, engineer-in-chief and electrician to the General Post Office; Rear-Admiral W. J. L. Wharton, hydrographer-in-chief to the Admiralty; Mr. Frederick Ward, manager in England of the Commercial Cable Company; the Marquess of Tweeddale, chairman of the Eastern Extension Telegraph Company (examined conjointly with Messrs. H. A. C. Saunders and F. E. Hesse); Mr. J. C. Lamb, third secretary of the General Post Office; Mr. H. Buxton Forman, controller of packet services of the General Post Office; Mr. J. H. Carson, manager of the Anglo-American Telegraph Company; Mr. R. K. Gray, engineer-in-chief and assistant to the managing director of the Silvertown Company; Mr. T. Playford, Agent-General for South Australia; Mr. W. P. Reeves, Agent-General for New Zealand; Mr. W. H. Mercer, of the Colonial Office (secretary to the Committee); Mr. B. T. Finch, director-in-chief of the Indo-European Telegraph Department of the Government of India; Mr. N. Cork, managing director of the Commercial Bank of Sydney; Mr. C. U. Kingston, secretary to the Australian Mortgage, Land, and Finance Company; Colonel Hozier, secretary of Lloyds; Mr. E. T. Duxat, chairman of Dalgety & Co., Limited.

Besides the evidence given by the gentlemen above named, a considerable volume of statements, memoranda, &c., put in by witnesses and others is appended to the report. We now reprint the report *verbatim* before dealing with some of the evidence upon which it is based, and discussing the conclusions arrived at.

The report runs as follows :—

1. The Committee have the honour to report that, having been appointed by the Secretary of State for the Colonies on June 2nd last, they held their first meeting on the 5th of that month; but that owing to unavoidable delays they were unable to begin the examination of witnesses until November 12th.

2. The Committee desire to express their obligations to Mr. Sandford Fleming, whose long labours on the subject of a Pacific cable have thrown much light upon the project and materially facilitated the task of the Committee, and to all the gentlemen who have been so good as to give evidence and whose answers range over the whole ground comprised in the reference to the Committee.

3. The Committee have carefully considered these answers and other materials bearing on the subject which have been laid before them, and have the honour to report as follows upon the questions submitted to them.

4. The Committee consider that the most convenient course will be for them to deal with the points submitted to them in the same order as laid down in the Instrument of Appointment.

I.—PRACTICABILITY.

5. No one disputes the practicability of the project from a technical point of view, although the depth, probably in places over 3,000 fathoms, is as great as that in which any cable has hitherto been laid. The Committee consider that a preliminary survey is indispensable, principally for the purpose of ascertaining, before the cable is laid, and of avoiding, while it is being laid, any serious inequalities in the bed of the ocean which might cause "suspension," and in course of time fractures, of the cable. Such a survey could, however, be made while the cable is being manufactured; it could be made by the contractors under the supervision of an officer appointed for the purpose by the owners of the cable; and the necessary provision for it, with all proper conditions, could be contained in the contract. The present information with regard to the route is sufficient for the purpose of estimating the expense of the cable, and it may be assumed that the further survey recommended would not lead to any material variation in the tenders.

6. Further, it will be necessary that a careful examination be made of the various islands to be presently mentioned with a view to ascertaining the best spots available for landing stations.

II.—ROUTE.

7. The Committee recommend that the route should be from Vancouver *via* Fanning or Palmyra Island, Fiji, and Norfolk Island, with branches from the last-named station to Queensland and New Zealand. No doubt there would be a decided advantage in taking the cable *via* the Hawaiian Islands, instead of *via* Fanning or Palmyra Island, as the section would in that case be shorter, and therefore less costly for the same speed, or faster for the same cost, and some traffic would, if no line is laid from California, be obtained from Honolulu. But this route would involve a departure from the principle of using only British territory for landing stations, and as this principle has been formally endorsed by the Canadian and Australasian Governments at the Conferences at Ottawa and Sydney the Committee consider that it should be adhered to, and that a departure from it would be a material change in the character of the scheme which was approved at those Conferences.

8. The length of the cable over the route recommended would be, allowing 10 per cent. for "slack" actually used, about 7,986 nautical miles, viz :—

Vancouver to Fanning Island, 3,561, or a little less from Vancouver to Palmyra Island;

Fanning Island to Fiji, 2,093, or a little less from Palmyra Island to Fiji;

Fiji to Norfolk Island, 961;

Norfolk Island to New Zealand, 537;

Norfolk Island to Queensland, 834.

9. The Pacific cable as a means of communication between Australasia and Europe would be, of course, dependent on the landlines across America and on the trans-Atlantic cables; and it would be necessary for it to have some working arrangement with them. Such arrangements are universal in the case of submarine cable companies, which must obviously make terms with the landlines by which their traffic is received or forwarded. The only telegraph line which at present runs from the eastern seaboard to Vancouver is that of the

Canadian Pacific Railway Company. This company is in connection at Oanso in Nova Scotia with the Commercial Cable Company, which possesses three cables from Great Britain to Oanso; and the nature of the arrangement between them is shown in the telegraphic correspondence contained in the Appendix to this Report. The Commercial Cable Company is an American company, but all the landing stations are on British territory. It is stated that the other trans-Atlantic cable companies, whether British or foreign, are in connection and alliance with the Western Union Telegraph Company, which is also an American company.

10. The Western Union at present effects its junction with the Canadian Pacific Railway Company's telegraph lines at Montreal, but it is highly probable that were a Pacific cable laid from Vancouver to Australia it would (if it does not already possess such a connection) make its own connection with Vancouver through the United States territory as far as British Columbia.

11. The effect of this position of affairs is, that the choice of routes would lie between an American cable company having its stations exclusively on British soil and in connection with a land system passing over British territory and controlled by a British company, and cable companies which, whether British or American, and which, whether possessing stations on British or American soil, are in connection with a land system controlled by an American company, and possibly passing through the greater part of its length over American territory.

III.—Cost.

12. The cost of laying the cable depends mainly on the materials used in it; and, as the quality of these can be tested, the question is practically one of quantity. The outer coverings are much the same in all specifications, according to the conditions of the case, but the conductor of copper and the insulator of gutta-percha vary in quantity in proportion to the speed of transmission required, and, therefore, the question of cost practically depends upon them, the heavier the cable in these respects the greater being the speed and the cost. With regard to all the sections, except the long one from Vancouver to Fanning Island, opinions as to the composition of the cable do not much vary, and as the speed of the whole line is limited, for through traffic, to that of the longest section, it will only be necessary to go into particulars with regard to that section.

13. On this branch of their inquiry the Committee have taken a large amount of technical evidence from electrical experts. This evidence has been in some important respects conflicting, and the Committee have been obliged to form their own conclusions, weighing one authority against another.

14. The principal points which the Committee have had to consider are:—

1. The weight per nautical mile of the core best suited for the purposes of the long section.
2. The theoretical speed of transmission obtainable from a given core over a given distance.
3. The deductions which have to be made from the theoretical speed of transmission to arrive at the actual practical speed in "paying" letters.
4. The number of hours per diem during which a cable can be worked for commercial purposes.

The Core—15. The cores recommended to the Committee varied from 500 lbs. copper and 320 lbs. gutta-percha (Mr. Siemens) to 800 lbs. copper and 550 lbs. gutta-percha (Mr. Preece, of the General Post Office), but the Committee have decided to select for detailed consideration from between those limits, two types, which have been recommended from different points of view.

16. The first would contain 552 lbs. copper and 368 lbs. gutta-percha, and was that recommended to the India-rubber, Gutta-percha and Telegraph Works Company by Lord Kelvin in November, 1895.

17. The Committee do not consider that it would be wise economy to lay down a cable of any lighter type than this. The speed of transmission would be reduced to too low a figure.

18. The second would contain 650 lbs. copper and 400 lbs. gutta-percha, and is that which was adopted for the cable laid by the Anglo-American Telegraph Company in 1894. There is a serious mechanical difficulty in handling cable of very heavy weight at great depths, and the Committee are of opinion that it would not be prudent in any case to lay a cable of a heavier core than this over the long section.

Speed, Theoretical and Practical.—19. It is, however, in connection with the speed obtainable from a given cable over a given distance that the opinions of the experts have differed most materially.

20. For instance, Dr. A. Muirhead gave it as his opinion that a cable of 552 lbs. copper and 368 lbs. gutta-percha over the long section would, with experienced operators, and by the use of the automatic curb method of transmission, give a speed of 80 letters per minute, and similarly, for a cable of 650 lbs. copper and 400 lbs. gutta-percha, 95 letters per minute.

21. Mr. Preece, on the other hand, stated that the same core as that last named, over the same distance, and by the same process, would give a speed of not quite 63 letters per minute.

22. For the same cable Mr. M. H. Gray, Mr. Lucas, speaking for himself and for the late Admiral Sir George Richards, and the representatives of the Eastern Extension Telegraph Company, estimated a speed of 70 letters per minute.

23. On the other hand, Mr. Siemens estimated the same speed of 70 letters per minute for a cable of 500 lbs. copper and 320 lbs. gutta-percha, while for a cable of 800 lbs. copper and 550 lbs. gutta-percha, Mr. Preece estimated a speed of 85 letters per minute.

24. Lord Kelvin wrote to the Committee that, in his opinion, they might reckon on getting 60 letters per minute, and that possibly they might get 80 letters per minute, out of a cable composed of a core of 552 lbs. copper and 368 lbs. gutta-percha over the long section.

In all cases the speed given was the theoretical speed for simplex working.

25. On the questions of the deductions which have to be made to reduce the theoretical to the practical speed, the divergence of opinion was not less remarkable.

26. The explanation of this is to be found in the fact that much depends upon the system on which a line is worked. Thus, in the case of the trans-Atlantic lines, where the competition is very keen and the hours of business comparatively limited, and where the regulations of the International Telegraphic Convention do not apply, it has been found possible to reduce the non-paying traffic to about 16 per cent.

27. On the other hand, on the Eastern lines the proportion is much higher, because the reserve power of the lines is very great, and therefore there is more margin for non-paying traffic, the working hours are practically longer, and the regulations of the International Convention have to be followed. Mr. Preece estimated that a theoretical speed of nearly 63 letters per minute for the core of 650 lbs. copper and 400 lbs. gutta-percha would be reduced in practical working to 28 paying letters per minute. Mr. Lucas stated that a theoretical speed of 70 letters per minute for the same core was equivalent to four or five paying words a minute. Mr. Lamb, of the General Post Office, said that a deduction of 55 per cent. must be made from the theoretical to find the practical speed of a given cable. Mr. Ward, manager of the Commercial Cable Company, calculated that a total allowance of 16 per cent. should be made for "dead" traffic; Mr. Carson, of the Anglo-American Telegraph Company, 15 per cent.; and Mr. Gray, of the India-rubber, Gutta-percha and Telegraph Works Company, about 17 per cent. Mr. T. B. Finch, director-in-chief of the Indo-European Telegraph Department of the Government of India, and having charge of the telegraphs from Karachi up the Persian Gulf and through Persia, stated that the average number of service indications which have to be forwarded with a message of 12 paying words of a length of eight letters each, would, on the average, be equivalent to 10 letters. Furthermore, he stated that the unavoidable use of the lines under his charge for administrative purposes would amount to less than 5 per cent. of the whole traffic. His estimate, therefore, of the total unavoidable "dead" traffic amounts to about 17 per cent.

By the theoretical speed of a cable the Committee understand the maximum number of words which can be transmitted in a minute so that an experienced operator can certainly and easily read them. The practical speed is the proportion of that maximum number which remains after certain deductions have been made for the transmission of words for which no revenue is received and for loss of time.

28. The Committee ascertained that these deductions were made on account of—

1. Service indications and prefixes, such as station of origin, number of message, time, date, &c.
2. Repetitions, errors in transmissions, corrections.
3. Necessary intervals between the messages, time lost by clerks, &c.
4. Administrative messages connected with the traffic.

There are, of course, other administrative messages which must necessarily be sent on the business of the line, but these could, in most cases, be left for periods when there was no traffic for transmission.

29. It must also be borne in mind, in considering this question, that though the speed of a cable is usually stated as being a certain number of words per minute, these words are "reputed" words of five letters each. In actual practice a word averages eight letters, the increase being due to the use of code words, and to the omission of many conjunctions and prepositions when messages are sent "in clear."

30. The so-called "words," however, which have to be added to each

message as service indications and prefixes, do not consist generally of more than two or three letters each.

31. After weighing all the evidence carefully, the Committee are of opinion that a deduction of 33 per cent. from the theoretical speed is amply sufficient to give the practical speed, or the paying traffic.

32. This estimate is a cautious one.

33. There is no apparent reason why, with good management, the "dead" traffic on a Pacific cable should not be kept much nearer to the level which obtains on the Atlantic than to that which obtains on the Eastern lines. In addition, however, must be taken into consideration unavoidable losses of time in each working hour, and the fact that the use of code words (usually long ones) is increasing.

34. It has also been stated in evidence that possibly a Pacific cable would have to comply with the regulations of the International Telegraph Convention, but in the case of a line touching only British territory this necessity may perhaps be avoided.

35. The estimate of 33 per cent. has been arrived at with the desire to include an allowance for every possible deduction from the earning power of the cable.

If the experience of the Atlantic cable companies can be relied on the percentage would be considerably reduced.

Number of Working Hours per Diem.—36. In this matter, again, the expert evidence was somewhat conflicting, but the Committee consider that an estimate of 18 hours per diem during which the cable could be worked would be a moderate one. A very small allowance for duplex working has been made in this calculation.

37. Duplex working is the system under which the same cable is made to transmit messages from both ends at the same time. It can be applied so as to add about 80 per cent. to the traffic sent by simplex working. But full advantage can only be taken of this system when the business hours are substantially the same at both ends of the cable. This, for instance, is the case between, say, London and Lisbon: as between London and New York, where the difference in point of time is about five hours, duplex is only regularly available for the few hours which may be considered part of the working day in both places: while as between this country and the east of Australia, where the difference is about 10 hours, so that night here is almost synchronous with day there, duplex working would only be resorted to to a small extent.

38. The conclusion the Committee have arrived at is that the core of 552 lbs. copper and 368 lbs. gutta-percha might reasonably be expected to give 40 paying letters a minute.

39. The core of 650 lbs. copper and 400 lbs. gutta-percha similarly would give 48 paying letters per minute.

40. To get the carrying capacity of these cables in a year the above numbers of letters should be multiplied by 60 (minutes to the hour); then by 18 (working hours per day); then by 300 (working days in a year). The totals on this basis would be:—

At 40 paying letters, or 5 paying words ... 1,620,000 words.

At 48 " " or 6 " " ... 1,944,000 "

41. Thus the lowest of these totals considerably exceeds the whole of the Australasian traffic in any year except 1895.

Cost of Laying.—42. The India-Rubber, Gutta-Percha and Telegraph Works Company has offered to lay the whole cable over the route

recommended, with the first of the above-mentioned types for the long section, for the sum of £1,517,000, this sum including the erection at each station of a suitable dwelling-house and operating room, with duplicate sets of all proper instruments; also the use of two cable repairing ships, with the cost of maintaining them as well as the cables themselves for three years.

43. This estimate included an allowance for 10 per cent. slack.

44. This allowance of slack is, in the opinion of the Committee, a reasonable one for actual laying, but they are of opinion that another 10 per cent. should be manufactured, which would be properly chargeable to the repair and maintenance fund to be hereinafter mentioned.

45. The condition as to maintenance for three years was laid down by the Canadian Government in inviting tenders, but though there is some convenience in thus having maintenance guaranteed for the first three years, the Committee consider that such a period is unnecessarily long as a test of the original condition of the cable when laid, without being long enough to prove its durability while under water; and they would recommend that the contractors should be required to maintain the cable for six months. With this modification the price would presumably be varied in approximately the following manner:—

	£1,517,000
Deduct cost of maintenance for three years; this was put at £40,000 a year for the two ships, and £30,000 a year for the cable used	210,000
	£1,307,000
Add for maintenance for six months at the same rate	35,000
Add for purchase of two repairing ships ...	80,000
	£1,422,000

or in round numbers, and leaving a margin of £78,000 for miscellaneous expenses payable out of capital, £1,500,000.

46. It seems probable that another firm would offer similar terms.

47. As regards the probable cost of a cable of the second of the above types, the information laid before the Committee is to the following effect:—

48. The Telegraph Construction and Maintenance Company estimated that the price for such a cable from Vancouver to New Zealand *via* Honolulu would be £1,870,000; this sum including the cost of five stations, estimated at £37,000. This distance (without slack) would be 6,352 nautical miles, and the longest span (Vancouver to Honolulu) 2,325. The route recommended is (without slack) 7,186, and the long section is about 3,200. The price of this type, therefore, on the basis of the above estimate, would considerably exceed £2,000,000.

49. The India-Rubber, Gutta-Percha, and Telegraph Works Company stated, in reply to a question from the Canadian Government, that their price for a 15 word per minute cable would be £1,672,000, and for 18 words £1,880,000; but specifications for these cables have not been given.

50. The representatives of the Eastern Extension Telegraph Com-

pany estimated the cost of the cable, with a core of 650 lbs. of copper and 400 lbs. of gutta-percha between Vancouver and Fanning Island, allowing 15 per cent. or more for slack, and including the cost of erecting stations and supplying apparatus, at about £1,650,000. The Henley Telegraph Works Company tendered for a cable of this type, with completely equipped and furnished stations and cable huts, for £1,492,000.

51. Mr. Preece also estimated that a cable, of a heavier core over the section to Fanning Island (800 lbs. copper and 550 lbs. of gutta-percha), would cost a little over £2,000,000. It seems therefore possible that a cable of the dimensions under consideration might be had for £1,800,000. It would not be prudent to put the whole capital required for such a cable at less.

Working Expenses.—52. The annual working expenses at the stations on the line may, the Committee consider, be put at £17,000, having due regard to their position and the cost of living.

53. For the central management £5,000 is allowed, making a total for annual working expenses of £22,000.

Maintenance and Repairs.—54. With regard to maintenance and repairs, it is of course impossible to forecast what interruptions would occur in any year and what expenditure would be incurred in restoring communication. It may, however, be remarked that repairs of a cable are the substitution of new material for old; so that in course of time the whole of the cable might be replaced; and this circumstance affords some guide as to the annual sum which should be set apart, on the principal of providing, not merely for the cost of annual repairs in case of interruption, but for the entire replacement of the cable, so far as might be found necessary, within some definite period. Thus the replacement of the cable would be completed in 40 years by laying 200 miles of cable a year; and taking the cost of cable, in round figures, at £200 a mile, this process would, on that basis, be effected by devoting £40,000 a year to this purpose. It is not suggested that it would be necessary to replace every part of the cable in such a period, or that such a sum would be expended each year on repairs; but the fact that the sum named would not only meet current repairs, but would in 40 years be equivalent to the replacement of the whole cable, indicates, in the opinion of the Committee, that it is as great a provision as need be made under this head. To it, however, should be added the fixed expenses of two repairing vessels, which may be put at £30,000, making £70,000 in all.

55. It should be added that the evidence clearly shows that the great depth of the Pacific will be a favourable factor in determining the life of the cable, while it will be an unfavourable influence on the facility and cost of the necessary repairs.

56. The provision suggested would therefore, it is estimated, in the shape partly of new cable and partly of unexpended balances, perpetually maintain the value of the cable as an asset.

Total Annual Charge.—57. To the expenses of working and maintaining the cable must be added the annual charge for interest, and provision for replacing the capital at the end of a certain period.

58. Having regard to the character of the work, the Committee think that a period of 50 years might reasonably be allowed for the latter purpose.

59. The rate of interest to be assumed must depend to a great extent on the conditions under which the capital is raised; and the Committee have therefore thought it better to append four estimates

of the total annual charge which must be provided for, varying according to the type of cable selected and the rate of interest.

60. In each case the sinking fund is calculated to replace the capital in 50 years.

	With a capital of £1,500,000.		With a capital of £1,800,000.	
	Interest at 2½ per cent.	Interest at 2¼ per cent.	Interest at 2½ per cent.	Interest at 2¼ per cent.
Interest	£41,250	£37,500	£49,500	£45,000
Sinking fund	14,311	15,387	17,173	18,464
Working expenses	22,000	22,000	22,000	22,000
Maintenance	70,000	70,000	70,000	70,000
Total	£147,561	£144,887	£158,673	£155,464

61. The Agent-General for South Australia, under instructions from his Government, placed before the Committee the claim of that Government to be compensated for the loss which they will sustain by the diversion of traffic from the line of telegraph which they erected across the continent of Australia, and over which a considerable proportion of the traffic now passes.

62. A somewhat similar claim may be put forward by the Eastern Extension Telegraph Company in the event of a cable being laid across the Pacific with Government assistance. No question of compensation has been referred to the Committee, and they therefore abstain from expressing any opinion upon the equity of any such claim.

63. The Government of India, whose position is in many respects similar to that of South Australia, have intimated that they do not propose to make any such claim.

IV.—REVENUE.

64. The revenue depends on the amount of traffic obtained, and there are no certain data by which this can be calculated. The representatives of the Eastern Extension Telegraph Company and Mr. Lamb, of the General Post Office, estimated that, on the total traffic of 1895, the amount which would be diverted to the new cable would be 872,297 and 620,000 words respectively. Mr. Sandford Fleming, for the reasons given in his evidence, put it at one-half the existing traffic. The Committee having considered all the evidence bearing on the subject, and feeling that they must in such a matter be actuated by extreme caution, select 750,000 words (which are between a third and a half) as a basis of calculation for the year 1896. They further consider that the estimate may assume an annual increase of this traffic at a rate of 10 per cent. In 1875 the amount of the Austro-

lasian telegraphic traffic was 235,160 words; in 1885 this had risen to 537,355 words; and in 1895 to 1,860,423 words. Thus the estimated rate of increase is considerably below the ascertained average increase of recent years; but special caution is advisable in drawing an inference from this, as the increase has lately been out of proportion to the increase of business so far as shown by imports and exports, thus probably indicating a change of habit in transacting commercial business which must have some limit, and further, the rather special circumstances of the Western Australia gold discoveries must be taken into account. There are no materials for estimating the probable increase in the American-Australasian traffic, which is at present very small, but it is likely that with a Pacific cable it would substantially develop. A little local traffic in the Pacific may also be counted upon.

65. These circumstances appear to the Committee to show the moderation of their estimate, but they have not failed to bear in mind the fact that the Eastern Telegraph Companies possess an old-established business, with wide connections, and that if any prolonged breakdown occurred on a Pacific cable, great injury might (in the absence of a duplicate cable) be inflicted on its business. On the other hand, the Atlantic Cable Companies in England would be interested in collecting traffic for a Pacific cable.

66. The amount of the through rate would depend on the terms made with the trans-Atlantic companies and the American landlines, but the Committee have been informed that a shilling rate could be obtained from Great Britain to Vancouver.

67. Taking, however, the existing rate to Australia of 4s. 9d. a word as a basis, and assuming that the existing rate of 1s. 6d. from London to Vancouver is maintained, a Pacific cable would be able to secure 3s. 3d. a word. On an estimated traffic of 750,000 words in 1898, this would amount to £121,875. If the tariff were reduced so as to admit of a Pacific cable retaining 2s. a word, the revenue would be £75,000, and at 1s. 6d. a word, £56,250. This calculation is based on the assumption that each word pays the full rate. No reduction is made for Government or Press telegrams, because allowance for this consideration has been made by the Committee in arriving at the above estimate of the total traffic, and after reckoning that similar proportions of Press and Government telegrams would be carried by a Pacific cable, and at similarly reduced rates to those now transmitted by the Eastern route. According to the returns of the Eastern Extension Telegraph Company for 1895, the press words were about 10 per cent. of the whole, and the Government words about 2 per cent.

68. The Committee have only to add, with reference to the financial question, that the cable would be a competitive line, and would have to be managed accordingly. While they have felt themselves bound, as they have remarked, to show extreme caution in their estimates, they consider that the question of expenditure, and still more the question whether a business approximating more to the capacity of the cable could be obtained, would largely depend, as would similar questions in all industrial enterprises, on the energy and care shown by the management.

69. The evidence has clearly shown that the best management, and the adoption of the most improved methods, can get much more paying work out of a cable than inferior management and the use of older methods.

Recommendation and Summary.—70. In consideration of the traffic estimated for the cable, and of the opinion expressed below, that a duplicate cable should be laid at the earliest possible moment, the Committee have arrived at the conclusion that a core over the long section from Vancouver to Fanning Island of 552 lbs. copper and 368 lbs. gutta-percha will be sufficient. On the assumption that this recommendation is adopted, and taking the total annual expenditure at £144,887, and the increase of business at 10 per cent. per annum on 750,000 words in 1896, a Pacific cable would, if it came into actual work on January 1st, 1900, earn £178,437 in its first year of working, if the rate obtained by it per word were 3s. 3d., thus leaving a credit balance on the first year's working of £33,550. If the rate per word were reduced to 2s., in the year 1900 it would earn £109,807; in 1901 £120,788; in 1902 £132,867; and in 1903 £146,153; it would thus become a paying concern during the fourth year of working.

V.—OWNERSHIP.

71. The Committee are of opinion that the cable should be owned and worked by the Governments interested.

72. In arriving at this conclusion, they do not underrate the importance of allowing all commercial undertakings to be carried out, whenever possible, by private enterprise unassisted by Government. But in the present case there seems to be no probability that private capital will be forthcoming for the purpose of laying a Pacific cable without a larger subsidy than the Governments interested in the project would be prepared to grant.

73. If Government assistance, in some form or other, is necessary, the Committee think that a scheme under which the cable would be constructed and owned by the Governments interested is much to be preferred to a private company working under a Government subsidy.

VI.—MANAGEMENT.

74. The Committee are of opinion that the general direction should be in the hands of a manager in London, under the control of a small board, on which the associated Governments would be represented. The manager would be in communication with the telegraph authorities of the respective Governments with regard to matters of local administration. The details could be arranged without difficulty by the Governments interested.

VII.—CONTRACT.

75. The contract would in the main follow the ordinary forms, specimens of which are shown in the Appendix. Provision should be made for a preliminary survey under the supervision of an officer appointed by the Governments, and for the maintenance of the cable by the contractor for six months, as recommended above. The cable in shallow waters should be protected by brass taping against marine insects. The details of the specification would present no difficulty when the type for the long section has been fixed upon, as there is not much difference between the present modes of constructing submarine cables.

Duplication.—76. The Committee have only to add that it would in their opinion be necessary to lay a duplicate cable, and that, if a

deviation from an all-British route were permissible in the case of a duplicate cable, and if the circumstances of the time permitted of it, such a cable might advantageously follow a somewhat different route, *via* Honolulu. Most cables on important routes have been duplicated, but generally in the first instance they have been laid singly, and the duplication has followed when the success of the undertaking warranted a fresh outlay of capital.

77. There can be no doubt, however, that the duplication should be effected at the earliest convenient opportunity. Cables have usually been duplicated to protect and preserve their business in case of interruptions, even when there have been no competing lines ready to profit by their breakdowns. Duplications would be, therefore, the more necessary in the case of a new line, which would be laid in competition with an existing undertaking.

78. If a second cable were laid along the same route as the first, the annual expenditure entailed by it might be reckoned at £37,000 less than that of the first, as the additional working expenses would certainly not exceed £15,000, and there would be no additional standing charges for repairing ships. If a second cable were laid *via* Honolulu, not only would there be the above-mentioned reduction in annual expenditure of £37,000, but also a very material reduction in the charges for interest and sinking fund, as the capital required would be less.

79. In the event, therefore, of a second cable being laid along the route recommended for the first, and on the assumption that the tariff were reduced to 2s. a word, and that such a reduction brought no increase of business beyond the 10 per cent. per annum already estimated, the total annual receipts from the two cables would exceed the total annual expenditure upon them in the tenth year from the commencement of the work of the first cable in 1900. If a second cable were laid along the cheaper route, or if the tariff were not reduced to 2s. a word, or if the annual increase of business exceeded 10 per cent., the period during which the total annual expenditure exceeded the total annual receipts would be proportionately shortened.

80. Moreover, the financial position of the cables would be a very strong one.

81. The custom of the owners of cables is to put by such a sum of money every year as will enable their cables to be kept in continual repair, and the old cable entirely replaced by a new cable within a certain number of years. This they consider to be a sufficient provision for the replacement of their capital. The Committee have, however, suggested that in the case of a Pacific cable there should be what practically amounts to a double replacement of capital. They have recommended that a sufficient sum should be set aside for annual maintenance to ensure the complete renewal of the cable within 40 years, so that at the end of that time the associated Governments should either be in possession of a new cable, or, if the old cable had not been wholly renewed, of a reserve fund sufficient to replace such part of the original cable as still existed. And, further, they have provided for the complete extinction of the original loan at the end of 50 years. These facts must be borne in mind in considering the financial prospects of the cable.

82. The Committee cannot conclude this report without expressing their strong sense of the value of the services rendered to them by their secretary, Mr. W. H. Mercer. It has been mainly owing to his

exertions that they have been enabled to carry through their work evenly and promptly since their regular sittings first commenced.

SELBORNE, *Chairman*.
DONALD A. SMITH.
A. G. JONES.
SAUL SAMUEL.
D. GILLIES.
GEO. H. MURRAY.

W. H. MERCEB, *Secretary*.

Colonial Office, January 5th, 1897.

Besides the General Report of the Committee which we concluded last week, another Report dated London, December 16th, 1896, was furnished to the Canadian Minister of Trade and Commerce by Sir Sandford Fleming, who was present during the examination of all the witnesses in the Colonial Office. This Report is not appended to the English Blue Book, but will be found on page 73 of the Canadian Blue Book, "Documents Relating to the Proposed Pacific Cable," Ottawa, [No. 51, 1899] issued on May 1st of this year.

We now propose to deal with the subjects on which evidence was collected by Lord Selborne's Committee:—

I. Is the laying of such a cable practicable from a technical point of view?

To judge of this it was first necessary to have information concerning the depth and nature of the bottom of the Pacific Ocean in the area through which the projected cable would probably pass.

At the inception of the Pacific cable scheme the information on the subject, although considerable, owing principally to the soundings obtained by the *Challenger* and the United States s. *Tuscarora*, was still so incomplete as to permit the opponents to the Pacific cable scheme to refer in the Press and elsewhere to the "vast and unexplored depths of the Pacific," and to allow the late Mr. Patey representing the Post Office, when giving evidence before the London Conference, 1887, to state that depths of 12,000 fathoms were found in the Pacific Ocean, a statement which also appears in a minute supplied to the South Australian Government by Sir Charles Todd, the Postmaster-General for that colony; needless to say, nothing approaching such a depth has ever been found in any ocean.

Since the Ottawa Conference in 1894 recommended a further survey, this work has been carried on, at first inter-

mittently, but lately almost continuously, by the Hydrographical Department. The soundings thus obtained are reinforced by the excellent lines of soundings made by the United States Government in 1892 from California to the Hawaiian Islands, preparatory to the laying of an American cable to connect these places. This survey took three months to make, and over 500 deep water soundings were taken.

As regards the Pacific Ocean generally, we have now some 1,950 soundings over 500 fathoms in depth, which relate directly to the route along which it is proposed to lay the cable, and there are altogether some 500 more, which throw some considerable light on the subject. It has been generally admitted in evidence that nowhere along the line is the depth much greater than that in which cables have already been laid and picked up, the greatest depth being some 3,200 fathoms, but the general average being considerably less. Mr. Lucas, although he considered the Pacific Ocean "a very favourable place for a cable, and a place where a cable will probably have a long life when once laid down," drew attention to the danger of shallow patches or of deep holes which might be encountered, a local depth up to 5,155 fathoms having been found.

Attention was also drawn to this point by the representatives of the Eastern Extension Company, but Sir Sandford Fleming's evidence shows that this local depression is many hundreds of miles off the cable route, lying, as it does, to the east of the Kermadec Islands, and 600 miles north-east of the northern point of New Zealand. In reference to this depression, Admiral Wharton, after giving his reasons for such an opinion, said: "I should not expect to find these very deep soundings on that long route," referring to the Vancouver-Fanning Island section. To the south of Fanning the soundings are already sufficiently numerous and well distributed to show that there is no likelihood of any such local depression existing in that portion of the route. Another such local depression is found in the Atlantic where 4,561 fathoms is met with within about 60 miles of two cables which were laid respectively in 1870 and 1871, and which are still working well and free from interruption.

Sir Saul Samuel managed to extract evidence showing that as far as the distribution of coral is concerned, the Pacific is very much freer from such danger than the route followed by the present cables to Australia; it was pointed out by Mr. Herbert Taylor that "the Red Sea is full of coral, the first

cable lasted many years very well." There are no less than four cables forming part of the Eastern Telegraph Company's system which pass through the coraliferous Red Sea, and these seem to be not much more subject to interruption than any other portions of this company's cables. It was also shown that for several hundreds of miles the Eastern Extension Company's cables to Australia lie in shallow and coral-floored seas.

As to the completion of the survey along the Vancouver-Fanning Island route, this should not take much more than three months, if it were undertaken in the same way as that adopted by the American Government in making the survey between San Francisco and Honolulu, and we understand that H.M.S. *Egeria* has been told off to do the work.

We are astonished to notice in Admiral Wharton's evidence that sounding operations are not carried on continuously during the 24 hours on the vessel engaged in this duty. As to the possibility of laying a cable between Vancouver and Fanning Island, none of the witnesses examined dispute the practicability of this, although varying opinions were expressed as to the size of core which might be necessary; but this latter point we will deal with under the heading of revenue.

As regards the landing places, it is to be regretted that this country long ago sacrificed her opportunity of taking over the Hawaiian Islands, which would have formed a convenient and important station on this route. In referring to Fanning and Palmyra Islands, Admiral Wharton draws attention to the steepness of the slope, but in Mr. M. H. Gray's evidence no difficulty is anticipated on this account. It is generally admitted that the bottom of the Pacific is soft, and of a kind favourable to the life of a cable; it is also stated by several of the witnesses that the depth of the water is a distinct advantage as far as concerns the durability of the cable.

With the general question of durability of cables we will deal later on.

As far as concerns the possibility of laying a cable of a class suitable for the Vancouver-Fanning Island section, some of the witnesses have, in our opinion, rather too readily assumed that a cable such as that laid across the Atlantic for the Anglo-American Telegraph Company in 1894 (having core of 650 lbs. of copper and 400 lbs. of gutta-percha per nautical mile) is the extreme possible limit of size and

weight. This opinion seems mainly to be founded on the fact that this cable is the largest which has hitherto been laid; and also that, as pointed out by Dr. Muirhead, the laying was not achieved without trouble.

The difficulty is reported to have been due to "the stiffness of the conductor"—the conductor in this case was made up of a layer of copper wires of small gauge, surrounding a very large central copper wire, and it is easy to understand that the knuckling of a thick non-elastic wire under bending or other strains is a disadvantage, inasmuch as it tends to the decentralisation of the conductor when a straight pull is put on the cable.

Whether, however, the difficulty experienced was due either to the defect inherent in such a type or to insufficient brake power is not of great importance, as this special style of core need not necessarily be regarded as limiting the possibilities of cables made up in other ways.

To sum up the evidence given as to the technical practicability of laying this cable, the matter seems to be beyond question perfectly possible, and we are quite in agreement with the opinion expressed in the report of the committee on this division of the subject.

II.—WHAT ROUTE SHOULD BE SELECTED FOR THE CABLE ?

In the instrument of appointment of the Committee this question is made to be dependent on the technical possibility of laying the cable, which, as will be gathered from what we have written above, is admitted by all the witnesses to be a matter of no exceptional difficulty.

When asking for tenders the Canadian Government specified eight distinct routes as alternatives, but almost by common consent of those interested and consulted, it has seemed that to meet all the requirements the cable should be laid from Vancouver to Fanning Island, from thence to Fiji, and on to Norfolk Island, whence it should bifurcate to New Zealand and to Australia.

As Mr. W. P. Reeves points out, this route was advocated at the Sydney Conference, where it was agreed to unanimously, as being to some extent a compromise between the conflicting opinions held by the representatives of New Zealand and Queensland. It was also pointed out by Sir Sandford Fleming that it was the only route where a cable could be established with advantage, cut off as we were from the possibility

of obtaining a landing on the Hawaiian Islands (which had not then been annexed by America), owing to a treaty agreement between the Governments of Hawaii and of the United States, and also owing to the dilatoriness of Her Majesty's Government in attempting to secure one of the outlying uninhabited islands near the Hawaiian group. This delay permitted of this island being formally taken possession of by the Hawaiian Government while the matter was under discussion in England. As Admiral Wharton pointed out in his evidence, "there is very little choice" as to the route which would fulfil the necessary condition of touching on British territory only.

It was pointed out by Mr. A. Siemens that it was of course advantageous on the score of economy to select a route with only comparatively small spans, but this, under the conditions, cannot be found. In his evidence, Mr. Playford said that he thought it was a mistake, a costly mistake, to carry the cable from Norfolk Island to New Zealand, as well as from that island to Australia. Now, as the length of the branch to New Zealand would be only 537 miles of a cable with a small core, costing about £53,000, the cost is comparatively slight, especially in view of the advantages to be gained.

Had Mr. Playford studied the charts, he would have seen that about half way between New Zealand and Australia there is a submarine ridge, running approximately N.N.W. from Lord Howe Island, and including the Chesterfield Reef, besides several small reefs and shallow coral patches, which lie between these places. This ridge is about 1,000 miles long and about 120 miles wide, and the water over it has a depth of about 700 fathoms, while on the Australian side of it the depth varies between 2,500 and 3,000 fathoms. On the New Zealand side the depth ranges from 1,500 to 1,900 fathoms. Indications of this danger are to be found in Sir Sandford Fleming's evidence. It is true that the cables which were laid between New Zealand and Australia in 1876 and 1890 have lasted well, the same is the case with the cable laid by a French company between New Caledonia and Australia in 1893, although all three cables are laid across this ridge. This is, we think, the worst part of the proposed line through the Pacific, and it is only a reasonable precaution, and not a costly one, to run a branch cable from Norfolk Island to New Zealand, which would be clear of the ridge, and thus, in case the Norfolk Island-Australia cable breaks down we would be assured of continuity

between Canada and New Zealand, and also in case of need be able to maintain communication with Australia by the existing lines.

In examining Mr. Lucas, Lord Selborne said :—"Now the Telegraph Construction and Maintenance Company, which you represent, criticised the proposals rather freely, the chairman—Sir George Henry Richards that would be, I suppose? (Mr. Lucas: Yes.) He objected to the conditions, and he objected also to the routes offered for consideration. Can you tell the Committee what it was in the proposals and route that Sir George Henry Richards mainly objected to?" Mr. Lucas, replying, said :—"He held very decided views upon that subject. In the first place, he was very strongly of opinion that the route should be the trade route, that the cable should go where the steamers call, that it should be laid in as short sections as the Pacific Ocean would allow. Then he was of opinion that for a cable to land on an island which is British was really very unimportant." The reference to the unimportance of the landing place being British was made more particularly in relation to the cutting of cables.

In Appendix B, which is a report on the tenders handed in, it will be found that the chairman of the Telegraph Construction and Maintenance Company objected to each of the eight routes specified, and proposed a new route taking in Honolulu and Samoa. In view of the treaty between the Hawaiian and American Governments above referred to, it is obvious that this route was an impossible one. The Marquis of Tweeddale, who was examined at the same time as Mr. H. A. Saunders and Mr. F. E. Hesse, expressed an opinion almost identical with that of Sir George H. Richards, and named the same islands as above mentioned, as landing places. In expressing disapproval of the proposed route, the gentlemen under examination pointed out that it was very deep water, and that there was almost always bad weather. The Marquis of Tweeddale said that the company which he represented "would be quite ready to negotiate for the laying of a Pacific cable on our own account, if we could select our own landing places, and the question of tariff for placed on a reasonable basis." He, however, took exception to the Vancouver-Fanning Island section, which his company could only use their best endeavours to maintain, and charge the Government with the cost of maintenance. Sir W. H. Preece also proposed two new routes, the first from Vancouver Island to Fanning Island, Canton Island, Fiji and

New Zealand; the second was similar to the above, but included Honolulu (between Vancouver and Fanning Islands). These routes, inasmuch as one of them includes the impossible Honolulu, and both exclude Norfolk Island, which was unanimously agreed to at the Sydney Conference, may be disregarded. It is, perhaps, worthy of note here that the overground distance between Vancouver Island and Fanning Island given by Mr. Preece with 10 per cent. slack included, is 3,628 nautical miles, while that put in by Mr. Lucas is 3,650, which is, in the case of the former, 86 miles, and in the case of the latter, 108 miles more than is given by Admiral Wharton, an unquestionable authority on this subject. The importance of this extra mileage in diminishing the speed of a long cable we will deal with under the heading of revenue.

Admiral Wharton, in speaking of the Fanning Island-Fiji section, pointed out that there were no soundings along two-thirds of this portion, and estimated an average depth of 2,700 fathoms varied by possible deep holes and rises in the bottom; which he characterised as very irregular. Since this evidence was given the route has been surveyed by the Hydrographical Department, and, with the exception of some inequalities in the vicinity of the Fiji Islands, the bottom has been found to be quite regular with an average depth of about 2,800 fathoms. Admiral Wharton also refers to the volcanic nature of this region, and points out that along the line from Fanning Island to the Phoenix Island group (one of which is the Canton Island of the route mentioned by Sir W. H. Preece) there are "a very large number of shallow banks, and also a depth as great as 3,400 fathoms."

The Hydrographer also points out that owing to the extreme steepness of the slope of the Phoenix Islands he doubted very much whether the cable could be laid there without a great deal of expense; this evidence bears strongly against the selection of Canton Island as a landing place. As regards the steepness of the slope of the islands along the selected route, the only one regarding which such a question arises is Fanning Island, which has not yet been surveyed; but it should be borne in mind that experience of this class of landing place is by no means of rare occurrence in cable-laying. Bermuda, Turk's Island, Porto Rico, St. Jago de Cuba and St. Thomas, are all instances of very steep slopes in the Atlantic, some of them being coral fringed, and the cables landed on these islands have given no exceptional trouble. Mauritius is another instance. Excepting on the

Fanning Island-Fiji section, Admiral Wharton's opinion of the selected route, although advanced with some caution, may be summarised as not at all unfavourable as far as the depth and the nature of the bottom is concerned. It is perhaps hardly worth while referring to the opinion expressed by Mr. Hesse, that *all* that portion of the route between Vancouver and Fanning Island is highly volcanic, as this opinion is neither supported by any known facts, nor does general knowledge of this zone in any way bear out such an assertion. We have gone into these points in some detail as they are all of importance in considering the route to be preferred. One of the advantages of a cable laid along the route chosen, is that the cable would land in the heart of the business district of Australia, thus avoiding the long land-lines which are a necessary adjunct to the present cable service and are a source of weakness. In going over the evidence relating to this portion of the subject, we have been much struck by the difference in the measurement of distance between similar landing places as given by the various witnesses, but on this, as on other points of the division of the report we are now considering, we are quite in agreement with the report as expressed by the Committee.

III.—WHAT WILL BE THE COST (a) OF LAYING, (b) OF MAINTAINING THE CABLE, AND (c) OF THE ANNUAL WORKING EXPENSES?

(a) In regard to this subject we will limit ourselves simply to the only route which has met with acceptance, viz., that which runs from Vancouver to Fiji, touching at Fanning Island, and continuing on from Fiji to Norfolk Island, whence it bifurcates to New Zealand and to Australia. The tenders put in at Ottawa in reply to the invitation of the Canadian Government, which had been entrusted with this work by the members of the Colonial Conference held in Ottawa in June, 1894, were as follows:—

The India-Rubber, Gutta-Percha, and Telegraph			
Works Company ...	...	...	£1,517,000
W. T. Henley's Telegraph Works Company ...	...	...	1,828,000
Siemens Bros. & Co. ...	...	...	2,170,000
Fowler-Waring Cable Co. ...	...	...	2,350,000

These tenders are based on the general conditions prescribed; they include in each case the manufacture and laying of cables, which shall have for each section a calculated speed of not less than 12 words per minute, the providing of

station buildings and instruments for the use of the staff, likewise the maintenance and repair of the entire length of the line for a period of three years after the whole line shall have been completed and put in operation. The condition being, that the cables are to be owned and controlled by Government, and to be worked under Government authority. Besides these tenders, a letter was received from the late Sir John Pender discouraging the project, and pointing out that a cable laid as intended would be quite useless, and would prove a commercial failure; but the writer wound up by stating that, if offered sufficient inducements, his company (the Eastern Extension Telegraph Company) could "undertake the work on better terms than could be offered by any other company." The chairman of the Telegraph Construction and Maintenance Company, after raising objections to each of the eight alternative routes for which tenders were asked by the Canadian Government, proposes a new route from Vancouver, taking in Honolulu and Samoa, and going to New Zealand only; trusting to the existing cables (the property of the Eastern Extension Company) for the communication between New Zealand and Australia. This cable he offered to lay for £1,870,000, which, however, does not include maintenance for three years, nor, indeed, for any period. The route here proposed would make the Pacific cable to a great extent a feeder for the system of the Eastern Extension Telegraph Company, who charge 3s. per message of 10 words, with 5d. for each additional word between New Zealand and Australia. Sir W. H. Preece gave the estimated cost of the cable which he had "sketched out" to meet the specification as £2,924,000; adding to this £159,900, the estimated cost of a cable from New Zealand to Australia, omitted in the above, and, also to make it comparable with the tenders, adding £180,000, the minimum amount estimated by Sir W. H. Preece to cover maintenance for three years, we have a total of £3,264,000. The extraordinary total of this estimate is apparently due, to those responsible for it, having in the case of the Vancouver Island-Fanning Island section taken too great an over-ground distance; to this excessive distance 20 per cent. of slack has been added, and on the erroneous length so obtained it has, for some obscure reason, seemed fitting to those who "sketched out" this estimate, to adopt a core weighing 940 lbs. of copper and 940 lbs. of gutta-percha per knot—a distribution of material inexcusable on either practical or economical grounds. In explaining away this

estimate before the Committee, Sir W. H. Preece pointed out that for the sheathing, steel wire costing £45 per ton had been adopted in this estimate (dated 1893), whereas steel of strength and quality amply sufficient for the purpose could be got for £12 per ton (in 1896), which item alone meant a reduction of £400,000 or £500,000 on this Post Office estimate!

In relation to the core, a diminution to 750 lbs. of copper and 600 lbs. of gutta-percha is suggested, and so the "revised" Post Office estimate of cost is arrived at, as being not much over £2,000,000. Even this revision is a very different story from that given in Mr. J. C. Lamb's letter of July 5th, 1893, which, as coming from the technical advisers of Her Majesty's Government, was circulated among the Colonial Governments by the Colonial Office, and thus three months after it was written, it turned up at the Antipodes in time to act as a damper on the mission of the delegates sent by the Canadian Government to Australia, to try to come to an arrangement with the Australasian Governments concerning the Pacific cable, among other things.

The representatives of the Eastern Extension Telegraph Company estimated the cost of laying a cable along the selected route at "something like £1,650,000" for the making and laying of the cable, erecting the stations, and supplying apparatus, but exclusive of maintenance. Mr. J. C. Lamb estimated the capital cost at £2,000,000, to which he applied £154,860 annually for interest at 3 per cent., maintenance and working, and sinking fund. Even this figure is just £72,304 less of an annual charge than that which Mr. Lamb gave in July, 1893. We may look on this also as a "revised" Post Office estimate. The same witness calls attention to the fluctuation in the price of material. In speaking of the estimate put in by his firm, Mr. Alexander Siemens pointed out that (just as was the case with the Post Office authorities) he had estimated for wire at £50 per ton, of which, as he showed, it would have taken about 20 years for the makers to supply the necessary 11,000 tons if turned out at the usual rate, but by adopting the usual deep-sea wire, giving 96 tons breaking strain per square inch, a reduction of some £500,000 could be made in his tender. As, however, Mr. Siemens says that when he sent in his tender, he did not look on it as a firm offer, but "only to give the Governments an idea what the thing might cost," it is not surprising that he did not go

into the figures so closely as Her Majesty's technical advisers, not being influenced by commercial strategy, might reasonably have been expected to do. The India-Rubber, Gutta-Percha Telegraph Company also submitted tenders for cables along the selected route, capable of giving a speed greater than 12 words. These figures were, for a 15-word per minute cable, £1,672,000, and for an 18-word per minute cable £1,880,000. We must bear in mind that the figures given in the actual tenders were submitted to the Canadian Government in October, 1894, and that the price of material, as pointed out in Mr. Chamberlain's letter of April 28th last, has since that date altered considerably, not enough, however, in the natural condition of the markets, to entail any very large increase.

(b) As to the cost of maintaining the cable for a period of three years after the completion of the whole line. In the case of each of those who submitted regular tenders, the cost of maintenance is included in the amount of the tender; but in the evidence the details of the amounts apportioned for maintenance are to be found. Mr. R. Kaye Gray allows for two cable-repairing ships at £20,000 per annum each, and also £30,000 yearly for 150 miles of cable which might be required. Messrs. W. T. Henley's Telegraph Works Company allowed £115,000 a year as the cost of maintenance, subject to a reduction if the spare cable provided for the purpose be not used. Messrs. Siemens made an offer of £90,000 a year for this purpose which included an estimated possible expenditure of 200 miles of cable; this estimate Mr. Siemens regarded as a full one, which, if continuous for 25 years, besides being regarded as a repair fund, would admit of the complete renewal of the cable. As regards the maintenance for three years, Messrs. Siemens make this offer, subject to a reduction, if the actual repairs cost less than the sum named. The Fowler-Waring Company stipulate that a fixed sum of £300,000 be allowed, to guarantee maintenance and repair for three years. Mr. Herbert Taylor estimated the cost of two repairing ships at £16,000 or £18,000 a year each, and as regards the cable required for possible repairs in the first three years, pointed out that the surplus cable left over after laying, which would probably amount to several hundreds of miles, would be available for purposes of repair, and that thus the annual bill for repairs and maintenance ought not at first to exceed £30,000 or £40,000. Admiral Wharton gave the annual cost of a surveying ship at about £12,000 a year. Mr. Hesse esti-

mated the annual cost of two repairing ships at £50,000, but could give no idea of the amount of cable required for possible repairs, while the Marquis of Tweeddale considered the risks so great along the Vancouver to Fanning Island route, that his company could not undertake to maintain it "on any terms."

This opinion seems to a great extent based upon the unfortunate experience which Lord Tweeddale had with the 1874 Atlantic cable and others of a similar class, but it should be borne in mind that these were laid when the knowledge of cable making and laying was comparatively elementary, and when a thorough survey of the ocean bottom was not looked on as requisite. Sir Sandford Fleming estimates the cost of maintenance at £50,000 (based on the figure of £6 per mile). Mr. Lucas gave no guide as to the cost, but said he had seen estimates made (he did not say by whom) for this particular cable, in which two maintenance ships were included, and it was estimated that they would be employed two months in the year each. Sir W. H. Preece gave £30,000 each as the cost of two repairing ships, and pointed out that the surplus cable after laying, would be available for repairs. Mr. Lamb gave £30,000 as the figure for maintenance, but stated that it was a low estimate. It certainly is considerably below the figure given by Sir W. H. Preece. Mr. Playford also quotes Sir Charles Todd, the Postmaster-General of South Australia, at some length, but it is, perhaps, better to ignore information coming from a source which, on several occasions in connection with Pacific cable matters, has been proven to be based on incorrect information. This can hardly be wondered at, as neither Sir Charles Todd nor Mr. Playford has any personal experience concerning cable matters, and thus they are forced to gather information as best they can.

(c) The annual working expenses—the amount set aside for this by Mr. R. Kaye Gray is £26,000 as far as staff is concerned. Mr. Siemens said that he did not think the expenses for the staff and offices would exceed £24,000 per annum. In Appendix "C" Sir Sandford Fleming, referring to this figure, says: "I have increased Mr. Siemens's allowance for management to £6,000, the two making in all £30,000 per annum. This charge will be constant, and will suffice, as pointed out by Mr. Siemens, for a business more than six times greater than that estimated for the year 1898, and by introducing duplex working for traffic 10 or 12 times greater." The amount required for working expenses

according to the representatives of the Eastern Company, would be something between £30,000 and £35,000 per annum.

Sir W. H. Preece could express no opinion on the subject from his own experience, but Mr. Lamb gave £10,000 as "a very low estimate of current expenses." There is a considerable variation in the opinions expressed above on the three points under consideration, but as regards (a) the cost of laying, we are in agreement with the opinion expressed by the Committee, always bearing in mind the variations which may have occurred in the price of raw material; and we also think the provision made for maintenance (b) is quite sufficient; but as regards working expenses (c), the £22,000 per annum recommended by the Committee might, with advantage, be increased by another £5,000 per annum.

IV.—WHAT REVENUE WILL ARISE FROM THE TRAFFIC WHICH MAY BE EXPECTED TO PASS OVER THE CABLE?

Before going into the amount of revenue which might reasonably be expected to accrue to the Pacific cable, it would be well to examine the evidence given relative to the traffic-carrying capacity of the core of the Vancouver-Fanning Island section, which will, of course, determine the through rate of speed of the whole line; we will, therefore, deal with this section alone. A certain amount of confusion was introduced by the fact that the usual standard "word" (of five letters) was not adhered to throughout. This standard is generally recognised and used in referring to the carrying capacity of cables, but we find that, amongst others, Sir W. H. Preece has not seen fit to adhere to it in this instance, although it is used throughout the latest edition of the "Hand-book of Telegraphy," of which he is one of the authors. In the advertisement for tenders, one of the conditions was that "the calculated speed for each section of the cable shall in no case be less than 12 words per minute." We find in the evidence that the India-Rubber Gutta-Percha and Telegraph Works Company amended the core which had been included in their tender (without asking for any corresponding increase in the price); this action was taken by them after receiving opinions from Lord Kelvin and Mr. Herbert Taylor, who were consulted by the company in view of the great difference between the core they had suggested in their tender, and the very heavy core estimated for by the advisers of the General Post Office.

It appears that there was a slight difference between the weights of the core originally calculated by this company and those given by Mr. Taylor and Lord Kelvin. The core adopted was that calculated by Lord Kelvin, viz. :—552 lbs. of copper and 368 lbs. of gutta-percha for a length of 3,560 nautical miles, which included 10 per cent. of slack after laying. In the case of W. T. Henley's Telegraph Company, the core is given as 650 lbs. of copper and 400 lbs. of gutta-percha ; no length is given by Mr. Theophilus Smith, who represented this company, but from his experience in laying other deep-water cables, the amount of slack required is given as from 7 to 8 per cent. ; by adding this 8 per cent. to 3,220 miles, which is the distance between Vancouver and Fanning as given by the highest authority, Admiral Wharton, we get 3,478 nautical miles as the length of cable after it is laid. Mr. Alexander Siemens proposed to use a core of 500 lbs. of copper and 320 lbs. of gutta-percha. The length of the span we are dealing with is given as 3,300 miles, but no mention is made of the amount of slack to be added. In the case of the Telegraph Construction and Maintenance Company, the core recommended had 650 lbs. of copper and 400 lbs. of gutta-percha, the length of the section, including 10 per cent. allowance for slack, being given as 3,650 nautical miles. Sir W. H. Preece, on being questioned, did not support the 940 lbs. of copper and 940 lbs. of gutta-percha core originally designed by the General Post Office authorities, but suggested another. We quote from the report :—Lord Selborne's question (No. 1,393) : " I wish to get this quite clearly, if you please. Whereas in 1893 you advised for this cable, or, rather, for this section of cable, a cable of the massive type of 940 lbs. copper and 940 lbs. gutta-percha ; the probability is, that if you were to reconsider the matter now in the light of more recent experience, you would recommend 600 gutta-percha and 750 copper " ? —" That is so. " On this Lord Selborne put the succeeding question, as follows :—" I need not point out that the difference of cost between the first and the second specification would be very great ? "

The Post Office core thus stands for the moment at 750 lbs. of copper and 600 lbs. of gutta-percha. The distance from Vancouver to Fanning Island is given as 3,298 miles, a figure which Sir W. H. Preece said would probably be confirmed by Admiral Wharton. This, however, was not the case, as the hydrographer made the distance 78 miles less, which is a matter of considerable importance in a long

cable, as the additional length means in this particular case the decrease of the carrying capacity of the cable by four or five letters per minute, or about 5 per cent. This remark also applies, but in a slightly different degree, to the length given by the Telegraph Construction and Maintenance Company, which exceeds Admiral Wharton's length by 96 miles. As regards slack, $12\frac{1}{2}$ is given here as the percentage amount to be added to the overground distance, thus making the length of the cable after it is laid 3,710 nautical miles. The representatives of the Eastern Telegraph Company took a core of 650 lbs. copper and 400 lbs. gutta-percha, and, after a slight discussion among themselves, agreed that from 13 to 15 per cent. of slack was the right thing. The distance between Vancouver and Fanning was given by Mr. Saunders as 3,300 miles, or 88 miles more than that given by Admiral Wharton, therefore a somewhat similar remark as to percentage decrease of carrying capacity as was made in the case of Sir W. H. Preece also applies in the case of the Eastern Telegraph Company. By adding the 15 per cent. we get 3,795 miles as the length of this section when laid. From Mr. Lamb's evidence we learn that the Post Office core is again changed, and now stands at 800 lbs. of copper and 550 lbs. of gutta-percha, this production being named "Post Office revised," and flatteringly alluded to as "Mr. Preece's model cable;" the amount of slack mentioned by Mr. Lamb in calculating the cost of the working and maintenance of the cable is 15 per cent., which, if added to the overground distance given by the Post Office, makes the cable have a length of 3,793 miles after laying. Mr. Herbert Taylor spoke of the core as 650 lbs. of copper and 400 lbs. of gutta-percha, and of the slack as being 10 per cent., but gives no lengths. Dr. Alexander Muirhead, in his evidence, stated that a core with 650 lbs. of copper and 400 lbs. of gutta-percha would be most suitable, as allowing for extra pressure of traffic, as with automatic curb transmission such a core would give 19 words per minute, but he gave no data as regards either length or slack. Mr. Reeves pointed out in connection with the slack requisite that the French cable laid in the Pacific between Australia and New Caledonia had only an allowance of $5\frac{1}{2}$ per cent. of slack. (This amount is given as 6 per cent. in the proceedings of the Telegraph Conference held in Sydney in 1896.)

We have given above the various opinions as to the weights and proportions of conductor and dielectric recommended by the various witnesses. For the sake of

comparison only, as to the relative carrying capacity of these cores, we will now assume a set of cables all of the same length, say, 3,600 nautical miles, but provided with the various cores mentioned by the witnesses, using the same standard for all. In this calculation we have the following result. In the last column we give the number of words which each core would carry, judged by a common standard, but taking the actual lengths as estimated after laying:—

	Over a length of 3,600 miles.		Over the lengths as estimated.	
	Core.	"Words" per minute.	Length.	"Words" per minute.
Silvertown Company ...	552/368	14.72	3,560	15 06
Henley's Company ...	650/400	16 7	3,478	17 87
Siemens Company ...	500/320	13.1	3,630	12 87
Construction Company ...	650/400	16 7	3,650	16 22
Post Office ...	940/940	30.07	3,710	28.32
	750/600	21.77	3,710	20.50
	800/550	21.66	3,793	19.51
Eastern Company ...	650/400	16 7	3,795	15 02
Mr. Taylor ...	650/400	16.7	...	...
Dr. Muirhead ...				

In the preceding table a noticeable feature is the difference in the estimated length of the cable when laid. Taking the two extremes we find that in the case of the Eastern Company and the Post Office, there is an excess of length over the Henley Company's assumed estimate, as great as 315 miles, which would mean in the case of similar cores, a reduction of 14 letters per minute, or, say, 19 per cent. in the carrying capacity of the cable. It is also noticeable that the greater lengths are those supplied by the Eastern Telegraph Company and the Post Office. The manufacturing companies, who in the course of their business have much more experience than either of these two, although they differ each from each, are all considerably under the Eastern Company and the Post Office in the lengths given. This difference to a great extent is due to the varying amount of slack, 10 per cent. at most is the figure given by those with the greatest experience of the subject. Several cables in the Atlantic have been laid with 10 per cent. or less of slack, and we do not know of any sufficient reason why the same should not be the case in

the Pacific. It is true that in the Atlantic this percentage used to be exceeded, but, with increasing knowledge, and with an improved type of cable and adequate machinery, this has been modified, very much to the advantage of those who own the cables, as the diminution in length means a corresponding increase in the carrying power of these cables. We have chosen the length of 3,600 miles in the table given, as this is the length taken by Dr. Muirhead, who is an acknowledged authority on the subject of the carrying capabilities of cables. Dr. Muirhead points out that the ability and experience of the clerk receiving the message is of much importance, as this governs the amount of the definition in the signals which is requisite for legibility. Thus, taking the core of 500/320, 3,600 miles in length, we are told that by using the automatic curb method of transmission as many as 90 letters (18 "words") per minute *can* be deciphered, but that the limit of speed under the same conditions, with an average clerk, would be 76 letters per minute working simplex (Mr. Siemens gives this in his evidence as 75 letters), or 70 letters each way if using the duplex method of transmission. With the core 552/368 for the same length and by the same methods, 87 letters (17.4 "words") would be transmitted simplex, and a total of 160 letters (32 "words" per minute) if working duplex. It is obvious that the duplex method with automatic curb transmission should be adopted over this long section. In speaking of the core 650/400, Dr. Muirhead says that "working with the same signals as you would get with the proposed cable of 500 copper and 320 gutta-percha at the rate of 70 letters per minute, a speed of 95 letters by automatic curb transmission, of 64½ by the ordinary method of transmission," could be obtained. Dr. Muirhead states elsewhere in his evidence, that by the introduction of the automatic curb system an increase of more than 40 per cent. in speed has been obtained, as compared with the ordinary method of transmission. For the core 650/400 over a length of 3,650 miles, Mr. Lucas takes the speed as 70 letters per minute; this is presumably without automatic curb transmission. Sir W. H. Preece, in speaking of the 650/400 core over a length of 3,628 miles, calculates a speed equal to nearly 63 letters per minute. We are afraid that this and the other calculations which the same authority gives *re* speeds are founded on an erroneous basis, as for the purposes of this calculation Sir W. H. Preece says that he has taken the two 1884 Atlantic cables of the Commercial

Company, each of which had a core of 350/300 and a united length of 4,699 miles, whereas the two cables which when united for the purpose of experiment gave the speed result he deals with, had a length of 4,512 miles, which looks as if the Southern one of the 1884 cables, which is 2,353 miles long, had been united with the 1894 Commercial cable, which is 2,161 miles long, the total length of these being 4,514, but the core of the newer cable being 500/320 instead of 350/300. If we are correct in our supposition, and apart from the evidence given by Mr. F. Ward, the figure mentioned as the total united length, seems to indicate this, Sir W. H. Preece's figures, which he says were based on a core of 350/300 throughout, must be fallacious. The representatives of the Eastern Company give the speed over a 650/400 core, presumably 3,795 miles long, as being 70 letters per minute. For a core 800/550 and a length of 3,628 Mr. Lamb gives (on the authority of Sir W. H. Preece) a carrying capacity of 85.6 letters per minute. Over a core of 550/350 Mr. Carson is of opinion that 80 letters could be carried. Mr. R. K. Gray gives 62 letters as the speed over 3,560 miles with a core of 552/368.

Besides the actual number of words or letters which a cable will carry, there arises in relation to possible revenue, or earning power, the question of how many letters go to the average word actually transmitted, and what proportion of unpaid-for words are necessarily transmitted in connection with the organisation of the cable, either as indications, &c., on the messages, or as service messages connected with the management of the line? It is obvious that the proportion of this dead traffic depends to a great extent, among other things, on the ability with which the cable in question is managed. Mr. Carson points out that on the trans-Atlantic cables under his control, the average length of the words transmitted is eight letters, and that of all the words which pass over these cables, 90 per cent. are paid for, and he estimates that on the Pacific cable, with a core of 550/350, and by using duplex, 10 paying words could be carried each way, or, say, 20 paying words per minute of eight letters each. Mr. Carson explained that his cables were worked on a specially arranged system of checking, and that his lines do not work under the rules of the International Convention.

As regards ordinary messages, the Commercial Cable Company find, according to a footnote attached to Mr. Ward's evidence, that 16 per cent. is the amount of dead work, or non-paying traffic carried over their cables. Mr.

R. K. Gray found that out of 100 messages to and from South America, picked out at random, the average number of letters to the word was 6.03 in the body of the message, and that the non-paying words carried came to about 13 per cent. of the traffic. X

Mr. Finch, the director-general of the Indo-European Telegraph Department of the Indian Government, which works in joint-purse agreement with the Eastern Telegraph Company, and carries a considerable proportion of their traffic, gave the average number of letters to the word as eight ("seven or eight"), and an average of 12 or 13 paying words to the message. From this gentleman's evidence we find that the non-paying words due to administrative work and indications or messages, &c., come to 15 per cent. of the total traffic. X

From this it will be seen that there is a fairly general agreement among the witnesses above referred to, as to the proportion of dead traffic carried over various cables, but the evidence which follows is of a different complexion. The representatives of the Eastern Company give 9.43 as the average number of words which is made up as explained by the following extract from the evidence :—

Q. 1,831. Could you explain exactly how you get at that 9.43?— Taking the ordinary Australasian traffic we find 473 words of Government messages, containing 2,652 letters, giving an average number of letters per word of 5.61. Then there are 2,608 Press words containing 16,185 letters, or an average number of letters per word of 6.21. Ordinary messages contained 44,664 words, or 341,332 letters, giving an average number of letters per word of 7.64 and the average taking all the words and letters together, comes out at 7.54. As the Government messages are carried at half rates, and Press messages at quarter rates, it is necessary to multiply the Government average by two, and the Press average by four, to arrive at the earning power of the cables at full rates. Consequently, the average length of fully paid words is 9.43 made up as follows:—Taking the percentages of the different classes of traffic (Government, Press and ordinary) for the whole year 1895, and multiplying the Government average by two, and the Press average by four, we find the Government messages work out at 11.22 number of letters; the Press 24.84; and taking the ordinary at 7.64, as above the net result is 9.43.

Rejecting, for the moment, the composite figure obtained, as above explained, we find that actually the average length of the word is 7.54. Basing his information on a month's actual traffic on the Aden-Bombay cable, the theoretical speed of which is given by Mr. Hesse as "about 150 letters per minute, the actual speed attained of payable letters during that month, there being 73 per cent. of loss through !

preambles, repetitions, service messages and delays through pausing in transmission." This is a very great difference from the figure given by the previous witnesses. It would almost seem as though the whole 24 hours had been taken into the calculation, although it is evident that this time cannot have been fully occupied. The Eastern Company say that the mean theoretical speed through from London to Australia, working simplex, is about 145 letters per minute, and that the paying letters actually carried would only be a quarter of that number, say, 36 letters. Such a result along the proposed Pacific cable would leave a margin of over 36 letters more, available for paying traffic, independent of the 15 per cent. of dead messages which would be required if the cable were worked by the method indicated by Mr. Carson.

Sir W. H. Preece gives the average number of letters per word in trans-Atlantic traffic as 7.3; this figure was arrived at by actually counting the words in the body of every message for the Anglo-American Company which passed through several postal telegraph offices, for two hours during six days, and should therefore be a very useful figure; making allowance for spacing, the word is taken for sending purposes as consisting of eight letters, and the non-paying words are given as about 48 per cent., a percentage of loss which it appears would increase as the clerks grew tired. Mr. Lucas says that "70 letters per minute would give you on the section from Vancouver to Fanning Island something like four or five paying words per minute, not more." Assuming these to be words of eight letters, this means a "dead" traffic of about 50 per cent. Dr. Muirhead, after premising that he is calculating on the basis of the experience of the Eastern companies, according to whom he says "as much time is given to preamble, &c., as to messages," goes on as follows: "on the assumptions, (1) that only average operators are employed; (2) that the average length of code words is nine letters; (3) that half the time of transmission is occupied with preambles, calls, services, and other unpaid matter; and (4) that duplex automatic curb transmission is adopted, a cable 3,600 knots in length of a core weighing 500 lbs. copper and 320 lbs. gutta-percha per knot would earn eight paying words per minute. The same length of 552 copper and 368 gutta-percha core would earn nine paying words per minute." From the above we gather that as the core 500/320 will, according to a previous answer given by Dr. Muirhead, carry 140 letters per minute

under conditions similar to those explained above, the non-paying words amount to about 50 per cent. of the traffic. It must be borne in mind here that Dr. Muirhead is not basing this figure on his own observations.

There is a considerable discrepancy between the figures given by the two groups of witnesses as representing the proportion of non-paying traffic; some of these are not expressly stated, and we have had to deduce them from various portions of the evidence, but those representing the Anglo-American Telegraph Company, the Commercial Company, the South American Cable Company, and the Indo-European Government Telegraph cables, all agree in giving the proportion of "dead" traffic transmitted as being between 10 and 16* per cent. of the total; whereas the Eastern Telegraph Company make this about 75 per cent., and the Post Office officials give about 48 per cent. at the lowest valuation. It is obvious that as far as estimating the "profit-earning" capacity of a cable is concerned, it is important that the line should be worked under the most economical system of management, and in the absence of fuller explanations we prefer to accept the figures given by the group of companies above mentioned; always bearing in mind that in the case of the Pacific cable, the messages in transit between England and Australia, which will undoubtedly form the bulk of the traffic, and which will pass through Canada, there will not be that necessity for the lengthy indications which, as Mr. Lamb points out, are used for purposes of International account, &c., on lines which pass through various foreign countries. Mr. Lamb expresses an opinion that every one of such indications would have to be sent on a Pacific cable, because the Australian Colonies are parties to the International Convention, but in question 2,255, this witness says, in reference to the creation of competition in charges between existing routes, "where States are concerned, the intention of the International Telegraph Convention is that one set of States shall not disregard the interests of another. In this case I think it might be shown that the Mother Country and the Australian Colonies—who are all parties to the International Convention—would be disregarding the interests

* In their report the Committee state that the non-paying traffic is given as 15 per cent. in the case of Mr. Carson, and 17 per cent. in the cases of Messrs. R. Kaye Gray and Ffinch, but an examination of the evidence will show that the figures which we have used more accurately represent the evidence given.

of India, which is also a separate member of the International Union."

In Mr. Finch's evidence we find the following in a letter from the Secretary of State for India:—"I am to enclose, for the information of Mr. Chamberlain, a statement showing the extent to which the Indian revenues are concerned in the existing lines; but, having regard to the considerations represented in your letter, Lord George Hamilton is not disposed to make this a ground of preliminary objection against any scheme for an alternative route to which Her Majesty's Government may attach commercial or strategic importance." This does away with the fear of any objection from India as an adherent to the Convention.

As regards the amount of traffic which would probably be directed over the Pacific cable, Sir Sandford Fleming has assumed this amount to be equal to half the existing traffic between Europe and Australasia; and this seems a very fair assumption, as, given equal rates over the Indian Ocean and the Pacific Ocean cables, and supposing both of these to be equally efficient, the Pacific cable has the advantage of landing in the vicinity of the business centres of Australia, the joint population of New Zealand, New South Wales, Queensland, and Victoria being 3,700,000, as against the 530,000 in Western Australia and South Australia, where the existing cables land, at Roebuck Bay and Port Darwin respectively. These latter landing places are connected to the first-named group of colonies by very long landlines, which do not give a satisfactory service. The land distance from the Port Darwin landing to Sydney is about 3,000 miles, while the length of landline from Roebuck Bay to Sydney is about 3,800 miles. For the above reasons, and also because the majority of the unrouted traffic will probably be sent *via* the Pacific, it appears to us that Sir Sandford Fleming has not been over sanguine in claiming 50 per cent. as the amount of traffic which will probably accrue to the Pacific cable. The total number of words transmitted between Australia and Europe in 1896 is given as 2,326,984. The representatives of the Eastern Extension Company assume that their line would retain all the West Australia and South Australia traffic, also one-half of that of Victoria and Tasmania, and one-quarter of the messages to and from New Zealand and New South Wales. We must say we cannot see on what foundation this reasoning is based; such a division seems an extremely hopeful one on the part of the company. Sir W. H. Preece goes into an interesting calculation, by

which he shows that assuming a cable which can only transmit three (paying) words per minute, and which is only worked for 10 hours per day, owing to the clerks being "tired," and only 300 working days in the year, then such a cable will not carry more than 540,000 words in 12 months. As the particular cable referred to was calculated by Dr. Muirhead and given when working duplex 20 eight-letter words per minute, and as the evidence shows that 25 per cent. is a very liberal deduction to make for non-paying traffic, we get 15 words per minute instead of three, and by the simple process of doubling the 10 hours (and Sir W. H. Preece gives no good reason why this should not be done), we get 20 out of the 24; this, at the narrow estimate of 300 days to the year, gives us 5,400,000 words per annum. Sir W. H. Preece seeks to reduce the possible working day of this cable to 10 hours by such reasoning as the following, in reply to Lord Selborne :—

1,370. I will assume your three words per minute, but I want to go very closely into this question of 10 hours. Ten hours, you tell us, is by practical experience what these telegraph cables work at?—It was my practical experience of the work of telegraphs generally. I want particularly to consider this part of the business as absolute estimate, and I want to have it confirmed or upset.

1,371. All business that comes to the telegraphs over which you have control can be cleared in 10 hours' working?—Yes, certainly. That is much more than our telegraph experience in England. It will be more like four or five hours.

1,372. Then supposing the work to be double, would it not be merely a question of staff to work 20 hours a day?—It would be a question of business more than staff, because you cannot attract it.

1,373. I said suppose the business to be doubled, could not that business be worked off on the same line in 20 hours by merely increasing the staff?—No, because I have assumed that the high pressure of course with this work cannot be maintained during the 24 hours, even with a fresh staff of clerks.

1,374. Why not?—For the reason that I gave, that clerks tire, and you cannot maintain high pressure for a long period.

MR. MURRAY.

1,375. And you cannot get the work at the right time?—That is another element. That is where the work does not come; it only comes in dribblets, as a matter of fact.

CHAIRMAN.

1,376. But supposing one office, we will say going to America, suppose on some great occasion an immense amount of work comes in during the day, that would be worked off during the night?—Of course.

1,377. And customers do not complain, as a general rule, because their telegrams may be delayed an hour or two?—No.

1,378. Is it your experience that they do?—I beg your pardon.

1,379. Is it your experience that if a telegram is handed in for Australia, we will say to-day, is the public fairly satisfied if they get an answer within a certain number of hours?—I think so. I think very well satisfied if they get an answer in 24 hours.

1,380. In 24 hours?—Yes.

1,381. And therefore, at a stress, arrears could be worked off during the night?—Yes.

1,382. That being so, I do not understand why you are of opinion that we are obliged to reckon the working of any cable at 10 hours as the only time at our disposal?—Because these calculations are based on the assumption that our maximum speed is obtained under great pressure, and that this great pressure cannot be maintained for reasons that I have given. You must not take a maximum speed as your working speed, but you must take a mean speed. That has varied very much by the companies I gave you.

1,383. But you cannot be accused of taking a maximum speed. You have, by a process which has interested the Committee very much, reduced the working speed down to three words a minute?—Yes.

1,384. That you do not consider a maximum speed?—No; I call that the ordinary working speed.

1,385. The ordinary working speed. Then why cannot that speed be maintained for as many hours over the line as you can find staff to work it?—So you could if you had the work.

We thus find that after reducing the paying words to four per minute by "a process which interested the Committee very much," and deducting from that limited output still another eight-letter word per minute, to ease the pressure of work, the relays of clerks, although tired of sending these three words per minute, could still continue transmitting the messages for a longer period than 10 hours out of the 24, if such work presented itself! It certainly must be admitted that it is more fatiguing to send three words per minute than, say, 18; and from that point of view it is really a cruelty to the clerk to deprive him of the extra word per minute under the plea of over-pressure, even although he has still the $3\frac{1}{2}$ words of non-paying traffic to relieve him of this strain.

We have gone into this portion of the subject at considerable length, as being probably that which would be of most general interest to readers of the REVIEW, and having examined the various opinions expressed as to the carrying capacity of various cores, and the relative proportions of paying and non-paying traffic, we will now refer briefly to the probable revenue which the Pacific cable might be expected to earn under the conditions which we have detailed. We have shown that on the part of the Eastern Extension Company, who are not unnaturally opposed to the laying of a competing cable, the estimated traffic, as allowed by them,

is unduly small, being only 672,000 paying words out of the 1,948,000, which formed the total transmitted in 1895; although, even with this division of the traffic, the Eastern Extension Telegraph Company anticipate a reduction in their receipts of £118,000, should the present rates be maintained (which cannot be expected), or an annual reduction of £197,000 in their revenue, should the rate be reduced to 3s. per word. This estimate appears to be made on the assumption of a non-elastic traffic, and the large increase in the volume of the traffic which experience leads us to expect, consequent upon any considerable reduction in the rate, has, apparently, not entered into this calculation. This is strange, as not long after the Eastern Extension Company reduced the Australian rate from 9s. 4d. per word to 4s. 9d. per word, the traffic increased so rapidly that the total revenue at the reduced rate soon exceeded that of any previous year. The representatives of the Eastern Extension Company, ignoring this experience, anticipate that they would be unable to pay dividends from the Australian traffic, and that "it would be unfair to make the telegraphing public of China, Java, &c., pay higher rates than necessary for the benefit of Australia." And yet, with this sensitive regard for the purse of the public, this company does not seem to realise the unfairness of subjecting the telegraphing public of India to higher rates than they should be charged, so that the Eastern Extension Company, who do not carry messages to Europe, should derive a benefit from the joint purse agreement which they have with the Eastern and other lines which do carry these messages. The Marquis of Tweeddale assumes that, taking a rate of 3s. per word between Australia and England, this amount would be divided up as follows:—2d. to Australia, 4d. for the transit of America, and 1s. for the Atlantic cable which carried the message, leaving 1s. 6d. as the share of the Pacific cable. Mr. J. C. Lamb pointed out that the Government officers in England could do nothing to collect traffic for the Pacific route, except in as far as they would be bound by an old agreement with the Anglo-American Telegraph Company, which was made between the Duke of Montrose, as Postmaster-General, and the Atlantic Telegraph Company and the Anglo-American Telegraph Company in 1868 (31 years ago). This agreement was scheduled to the Telegraph Act, 31 and 32 Vict, c. 110, and the seventh clause is as follows:—"The Postmaster-General to hand to the companies in London all messages which can be sent by the companies' cables, and the companies to hand to the Post-

master-General in London all messages received through the cables, unless otherwise expressly required by the sender in either case." No limit of time is mentioned in this agreement, but it appears that a memorandum was passed between the Postmaster-General and the companies relative to the above Act of Parliament, by which the agreement is limited to 30 years, with clauses providing for a revision of its terms at various specified periods. As the 30 years mentioned in the memorandum have expired, it would be of interest to know what revision has been made, as the Act must have the effect of placing the majority of the Atlantic traffic originating in the United Kingdom at the disposition of the Anglo-American Telegraph Company, who are thus, to a great extent, supported by the English Government against competition.

Mr. Lamb criticises the possible action of the Commercial Cable Company in regard to the collection of traffic for the Pacific route, by saying that it would "give rise to a certain amount of adverse comment that a competitive foreign company was practically acting as agent for a Government line," which presumably means that it would be indelicate on the part of the Commercial Cable Company to attract traffic over their cable, if to reach its destination such traffic had ultimately to pass over the Pacific cable.

Mr. Lamb also said that the Post Office could do nothing towards procuring traffic for the Pacific cable, but does not say by which *via*, "Pacific" or "Eastern," the unrouted messages handed in at English telegraph offices would be sent. In virtue, however, of the Act above cited it appears that the English Post Office would be compelled to hand all unrouted traffic for Australia over to the Anglo-American Company, which is, of course, equivalent to routing this traffic *via* Pacific. This witness agrees pretty nearly with the Eastern Extension Company's representatives in estimating that one-third of the traffic from Australia would be all that would fall to the share of the Pacific route, and that with a 3s. rate the Pacific cable would retain about 1s. 6d. At this rate Mr. Lamb estimates that for the first year the revenue of the Pacific cable would be £46,500, and that, with a traffic increasing at the rate of 7 per cent. annually, in the tenth year the revenue would be £85,480. In general reference to the laying of the Pacific cable, after referring to the probabilities of cables being laid across the Pacific by foreign Governments, the chairman put the following question to this witness:—

2,395. You would rather see a cable across the Pacific going to Japan and China and to Australia respectively entirely in foreign hands than you would see a British cable in British hands if it was subsidised by the British Government?—Well, I would rather put my answer in this way: that I doubt whether the British Government would be justified in subsidising the cable across the Pacific in order to prevent a foreigner from laying a cable, but of course I would prefer that the whole enterprise, if it is carried out, should be in the hands of the British.

Mr. R. K. Gray pointed out that New South Wales, Victoria, Queensland, and New Zealand being interested in the Pacific cable and controlling the collecting stations, would probably give all their messages to this cable, while in England all the trans-Atlantic cable companies would be anxious to have an increase of traffic, and would therefore become collectors for the Pacific route in Great Britain. The Eastern and the Indo-European Telegraph Companies being the only collectors in Britain for the existing cables have 16 collecting offices in the United Kingdom, while the trans-Atlantic companies have amongst them 58 collecting centres.

Mr. Reeves in his evidence laid stress on the steady growth of telegraph business in New Zealand during years in which this colony was "not specially prosperous." Mr. N. Cork expressed the opinion that the volume of telegraph business with Australia is constantly increasing, his own experience being that between 1891 and 1896 the increase in the number of messages was 63 per cent. The witness also gave an interesting account, showing how the use of the telegraph is gradually but steadily growing in banking business as the rates are decreased. The evidence given by Messrs. T. E. Doxat and C. U. Kingston fully corroborated the opinion expressed by Mr. Cork.

Sir Sandford Fleming, on a basis of a 3s. rate between England and Australia, assumes that the Pacific cable will take 2s. of this amount, and that 50 per cent. of Australian traffic, including the traffic which will arise in Canada, will accrue to the Pacific line. He also pointed out that during the last 20 years the average increase in traffic had been 36·4 per cent., and that in his estimates he had taken less than half of this increase on which to base his calculations.

According to the estimates made by Sir Sandford Fleming, founded on a very moderate treatment of the continuously-increasing receipts accruing to the existing companies for the 20 years preceding the date of his calculations, we find that he has taken 1898 as the first full year that the cable could

be in operation, and that the gross earnings, reckoned at the low rate of 2s. per word for the Pacific cable, would amount to £110,000; for the year 1899, £126,500; and for the year 1900, £143,000. If from these estimated yearly earnings we deduct in each case the fixed charge for interest and working expenses of £75,000, we would have a surplus in 1898 of £35,000, in 1899 of £51,500, in 1900 of £68,000, showing a total surplus of £154,000 for the first three years the cable would be in operation. After these first three years, during which the cost of maintenance would fall on the contractors, this item would be a charge against surplus earnings. Sir Sandford Fleming has taken the annual cost of repairs and maintenance, interest, and working expenses, at £125,000, and allowing for this he finds that the total surplus in 10 years would amount to £742,000 on the assumption that the volume of traffic would increase at the normal rate. The low rate of interest payable on capital, owing to the guarantee of the British Government, is an important feature in these estimates. Apart from the figures given above, Sir Sandford Fleming directs attention to an advantage frequently overlooked, and to which the Committee make no reference in their report, viz, that the reduction of rates from 4s. 9d. to 3s. per word will, within the first year after the Pacific cable brings such reduction about, effect a gross saving in Australasia and the mother country of £190,000, a saving which will be repeated annually, and will be continually augmented by the growth of business. The indirect advantage to Canada will be great, and as the Pacific cable is now receiving the support of the Home Government, and absolute cash returns do not count for everything in the matter, we may well consider the indirect gain to the Dominion as not the least of the prospective profits. Miss Flora Shaw has pointed out that "Canada commands the commercial high road of two hemispheres," and the establishment of the Pacific cable is a necessary adjunct to this highway, all the more advantageous that, in itself, it will be self-supporting, if not a source of profit.

In their report the Committee are careful to state that they have been "actuated by extreme caution," and although we think that as regards the probable revenue the report is too conservative, still we are glad to see that here, as in other divisions of the report, the Committee have refused to accept, blindfold, the opinions and figures advanced by the representatives of the Eastern Extension Telegraph Company and

other declared opponents to the Pacific cable, and this even, although the officials of the English Post Office have, in almost every instance, been more or less in agreement with those who have vainly sought to quash the project. In his report to the Canadian House of Commons, Sir Sandford Fleming has written very strongly concerning what appears to him to be an extraordinary unanimity of opposition; but we do not propose here to go further into this aspect of the matter. We have been contented to deal with figures and statements as we find them given in evidence, and our readers, like Lord Selborne's Committee, may find much interest in the process by which the figures and opinions of some of the witnesses have finally been arrived at.

VI.—IF THE CABLE WERE TO BE NATIONAL PROPERTY,
WHAT WOULD BE THE PROPER METHOD OF MANAGE-
MENT AND ADMINISTRATION?

We are quite in agreement with the report of the Committee on this head—that the general direction should be under the control of a small board, on which the associated Governments would be represented. It is true that, to avoid the petty jealousies which have frequently arisen in the past amongst the Australasian Colonies, it might be necessary to have a larger board than that which would be absolutely necessary for fair representation of the various parties to the Pacific cable scheme. But as the interest is a common one, we do not anticipate that much difficulty or delay would be caused by a very full representation. We are, however, clearly of opinion that it would be a most regrettable mistake to place on such a board any of these gentlemen who have shown themselves adverse to the laying of the Pacific cable. In the establishment and management of this work neither pessimism nor incompetence should have a part. There are not the qualities which are required to establish a satisfactory position in the face of powerful opponents.

VII.—WHAT SHOULD BE THE FORM OF CONTRACT
OFFERED TO A CONTRACTOR FOR ITS CONSTRUCTION?

The Committee only touches lightly on this point, which, in view of the variety of opinion expressed in the technical evidence, is of some importance. We think that, as this is a subject connected with long deep-sea cables which have not as yet come under the control and experience of the Post Office authorities, it would be best that the Board of Management should nominate three representative cable engineers, profes-

sionally independent of each other, and unconnected with any manufacturing company. The engineers thus selected to draw up and submit to the Board of Management such specifications and terms of contract as they may agree upon; this draft form of contract should then be sent to each of the manufacturing firms, who should return the draft to the Board with such notes or suggestions as they may think necessary. The final form of contract on which tenders would be invited from manufacturers could then be decided on by the Board in consultation with their engineers. By this means the Board would have the advantage of finding before it the fullest information on the subject to be decided upon, as well as the opinions of all those most competent to deal with the matter. We are perfectly aware that this is not the usual procedure, but it appears to us the method from which the best results may be derived.

We have now dealt with all the points mentioned in the instrument of appointment of the Committee, but in the course of the evidence a considerable amount of attention was drawn to the question of duplication, a question which goes hand in hand with that of the durability of cables. Lord Tweeddale raised the question as to the need of duplicating cables, and in answer to a question (No. 1,968) says that duplication is a principle on which his companies have acted, and, again, in reply to question No. 2,107 *et seq.* says that duplication is an absolute necessity for safety. Sir W. H. Preece cannot call to mind "a single instance in which reliance has been placed in a single cable." There is no doubt that there would be an additional load on the Pacific cable cost were only the above opinions correct! But elsewhere in the evidence these opinions are not supported. Lord Tweeddale himself makes reference to the company's cable from Madras to Penang, but appears to forget that this main line cable to Australia and the Far East, laid in 1870, remained unduplicated for 21 years, also that his second Penang-Singapore cable was laid 22 years after the first, further, that nine years elapsed before the laying of the second cable from Java to Port Darwin, thus duplicating the only connecting link with Australia; again, that his company did not lay a duplicate cable from Australia to New Zealand until the first one had been working for 14 years, and finally, that the solitary cable which was laid between Singapore and Banjoewangi 20 years ago, and which is the only submarine cable link now connecting Australia with Singapore and the rest of the world, is only duplicated by the use of the Dutch landlines

through Java. Thus, in the history of the Eastern Extension, &c., Company alone there is to be found an object lesson on the need for immediate duplication of cables! There are numerous other similar instances which may well have escaped the attention of Sir W. H. Preece, but which should have been well within the knowledge of the representatives of the Eastern Extension, &c., Company. We could cite many instances in support of our opinion that the durability of well designed cables, laid after a careful survey has been made, is much underrated, owing to the shortness of the life of many ill-designed lines, but space will not permit us to enter on this. The Committee advise the laying of a duplicate cable, which they think would be advantageous, although not an immediate necessity.

There are many points of minor interest on which we might enlarge, but it is sufficient that the principal considerations have been laid before the readers of the REVIEW, fairly and impartially, we believe. We cannot leave this subject without an expression of hope that the Pacific cable project, now on the verge of accomplishment, and which we have consistently and continuously advocated ever since its inception, may be successfully achieved, and we also hope that in time even those who have not strenuously opposed it, may agree with us in the opinion that the establishment of such a cable is of the greatest importance to the progress and unity of our empire.

